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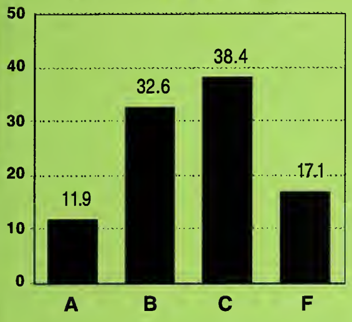
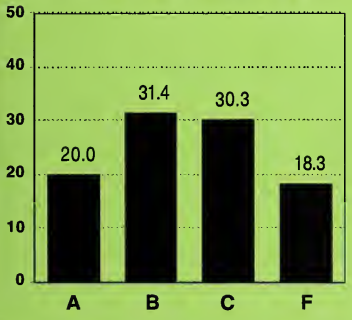
Mathematics 33

Diploma Examination Results
Examiners' Report for January 1996

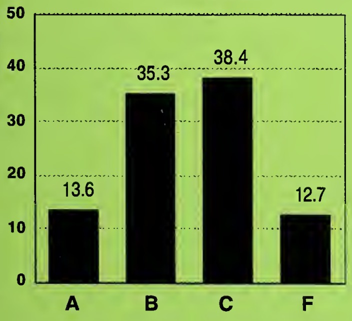
School-Awarded Mark



Diploma Examination Mark



Final Course Mark



The summary information in this report provides teachers, school administrators, students, and the general public with an overview of results from the January 1996 administration of the Mathematics 33 Diploma Examination. This information is most helpful when used with the detailed school and jurisdiction reports that have been mailed to schools and school jurisdiction offices. An annual provincial report containing a detailed analysis of the combined January, June, and August results is published each year.

Description of the Examination

The Mathematics 33 Diploma Examination consists of three question types: 37 multiple-choice questions worth 53%, 12 numerical-response questions worth 17%, and four written-response questions worth 30% of the total examination mark.

Achievement of Standards

The information reported is based on the final course marks achieved by 4 786 students who wrote the January 1996 examination.

- 87.3% of the 4 786 students achieved the acceptable standard (a final course mark of 50% or higher).
- 13.6% of these students achieved the standard of excellence (a final course mark of 80% or higher).

Approximately 49.5% of the students who wrote the January 1996 examination were females.

- 87.4% of the female population achieved the acceptable standard (a final course mark of 50% or higher).
- 15.3% of these students achieved the standard of excellence (a final course mark of 80% or higher).

Approximately 50.5% of the students who wrote the January 1996 examination were males.

- 87.2% of the male population achieved the acceptable standard (a final course mark of 50% or higher).
- 11.9% of these students achieved the standard of excellence (a final course mark of 80% or higher).

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Provincial Averages

- The average school-awarded mark was 62.0%.
- The average diploma examination mark was 64.5%.
- The average final course mark, representing an equal weighting of the school-awarded mark and the diploma examination mark, was 63.8%.

Of the 4 786 students who wrote the January 1996 examination, none have written a previous Mathematics 33 Diploma Examination.

Results and Examiners' Comments

This examination has a balance of question types and difficulties reflecting the philosophy of the Mathematics 33 Course of Studies. It was designed so that students who are achieving the acceptable standard in Math 33 can obtain a mark of 50% or higher. Students who are achieving the standard of excellence in Mathematics 33 should obtain a mark of 80% or higher. The student who is achieving the acceptable standard or the standard of excellence is expected to be able to achieve the curriculum standards identified in the *Mathematics 33 Information Bulletin, Diploma Examination Program*. At least 80% of the examination includes questions and tasks that students who achieve the acceptable standard should be able to complete successfully. The remaining part of the examination includes questions and tasks that students who achieve the standard of excellence should be able to complete successfully.

Future examinations will continue to focus on assessing students' understanding of mathematical concepts and on problem solving. Students will continue to be expected to solve problems, explain solutions, justify solutions, and/or apply concepts and procedures in the written-response section. The design of future field tests and examinations will include items that assess how well students have achieved the general learner expectations stated in the Mathematics 33 Course of Studies.

Blueprint

Question	Key	Difficulty	Rltns. & Fn.	Quad. Fn. & Eqns.	Powers & Rads.	Poly. & Rat. Exp.	Trig.	Stat.	Ann., Mtg. & Loans	Math Und.
MC 1	C	77.1	√							C
MC 2	A	94.1	√							P
MC 3	B	64.8							√	P
MC 4	B	72.1							√	P
MC 5	C	66.4							√	P
MC 6	D	45.6				√				C
MC 7	B	74.2	√							C
MC 8	A	73.7	√							C
MC 9	D	57.3	√							C
MC 10	B	85.0	√							C
MC 11	B	51.1	√							C
MC 12	B	63.0	√							PS
MC 13	D	44.7	√							PS
MC 14	D	73.7					√			C
MC 15	A	70.3					√			C
MC 16	A	79.3			√					P
MC 17	B	79.3			√					P
MC 18	D	65.7			√					P
MC 19	D	68.9			√					P
MC 20	B	69.8			√					PS
MC 21	B	84.7			√					PS
MC 22	B	52.1				√				C
MC 23	C	81.8				√				C
MC 24	A	79.5				√				C
MC 25	D	67.5						√		P
MC 26	B	48.7					√			PS
MC 27	C	95.5	√							P
MC 28	D	52.4		√						P
MC 29	D	77.7		√						C
MC 30	A	68.8		√						PS
MC 31	A	59.5		√						P
MC 32	A	66.9		√						C

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Question	Key	Difficulty	Rltns. & Fn.	Quad. Fn. & Eqns.	Powers & Rads.	Poly. & Rat. Exp.	Trig.	Stat.	Ann., Mtg. & Loans	Math Und.
MC 33	C	63.4		√						C
MC 34	A	67.0		√						C
MC 35	B	41.0						√		PS
MC 36	D	71.1		√						PS
MC 37	B	83.2						√		C
NR 1	45	36.3						√		P
NR 2	6624	41.6							√	P
NR 3	1	68.3		√						C
NR 4	325	76.8					√			P
NR 5	22	31.2				√				P
NR 6	66	37.3					√			PS
NR 7	15.6	39.0					√			PS
NR 8	144	50.2					√			PS
NR 9	51	59.6		√						P
NR 10	12.5	47.5		√						P
NR 11	33.6	76.2		√						P
NR 12	5	66.3						√		P
WR 1	–	78.8	√							PCPS
WR 2	–	61.3				√				PCPS
WR 3	–	56.8					√			PCPS
WR 4	–	58.3						√		PCPS

btests

hen analyzing detailed results, please bear in mind at subtest results **cannot** be directly compared.

sults are in average raw scores.

achine scored: 31.67 out of 49

ritten response: 13.9 out of 21

ourse Content

Rltns. & Fn.	Relations and Functions	11.1	out of	15
Quad. Fn. & Eqns.	Quadratic Functions and Equations	7.8	out of	12
Powers & Rads.	Powers and Radicals	4.5	out of	6
Poly. & Rat. Exp.	Polynomials and Rational Expressions	6.6	out of	11
Trig.	Trigonometry	6.2	out of	11
Stat.	Statistics	6.4	out of	11
Ann., Mtg. & Loans	Annuities, Mortgages, and Loans	2.5	out of	4

Mathematical Understandings*

- Procedural (P): 13 out of 20
- Conceptual (C): 12.5 out of 18
- Problem Solving (PS): 6.2 out of 11

*Refer to Appendix F of the 1995–96 *Mathematics 33 Information Bulletin, Diploma Examinations Program,* for an explanation of mathematical understandings.

A pilot flying over Glacier National Park observed and reported a potential avalanche in the Rogers Pass.

28. Park wardens used a Howitzer gun to set off a controlled avalanche. In order to calculate the time of flight for an explosive shell to reach a height of 2500 m, wardens used the quadratic equation $4.9t^2 - 800t + 2500 = 0$, where t is the time in seconds. The possible solutions for t are

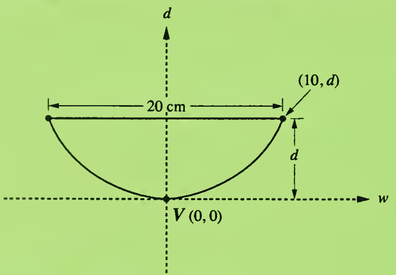
A. $\dfrac{800 \pm \sqrt{689000}}{9.8}$

B. $\dfrac{\pm 800 \pm \sqrt{689000}}{9.8}$

C. $\dfrac{\pm 800 \pm \sqrt{591000}}{9.8}$

•D. $\dfrac{800 \pm \sqrt{591000}}{9.8}$

To design an aviation light, a designer used a computer-assisted design program and made use of quadratic functions. The designer used the function $d = \frac{1}{8}w^2$, where w is one-half the total width in centimetres, and d is the depth in centimetres, to describe the reflecting surface of the light. A graphical representation of the function when the reflecting surface is 20 cm wide is shown below.



Numerical Response

10. If the aviation light must be 20 cm wide, then its depth d, to the nearest tenth of a centimetre, will be ____________ cm.
(Record your answer on the answer sheet.)

Answer: 12.5

Multiple-Choice and Numerical-Response Questions

Questions on the examination were grouped around real-life scenarios. The multiple-choice and numerical-response questions were mixed within the scenarios of the exam and where applicable, questions from the same unit of the course were organized together. Teachers involved in the January marking session stated that the mixing of questions by types and units posed very few problems for students and requested that this format continue to be used. It was felt that the embedding of written-response questions within scenarios enhanced the opportunity for student success. A discussion of how well students met the curriculum standards in the units Quadratic Functions and Equations and Trigonometry follows.

Quadratic Functions and Equations — To achieve curriculum standards for this unit, students should be able to construct, connect, analyze, generalize, and interpret the relationships between quadratic equations and graphical models that reflect real-world contexts in two variables. Multiple-choice questions 28 to 33 and numerical-response question 10 asked students to demonstrate their understanding of this unit. Multiple-choice question 28 asked students to solve a quadratic equation in a real-world context. About 52.4% of all students who wrote the examination met the expectation for this question. About 52.2% of the students who achieved the acceptable standard but not the standard of excellence on the examination were able to achieve the expectation for multiple-choice question 28. Of the students who were not able to achieve the acceptable standard, only 22.2% were able to meet the expectation. For students who met the standard of excellence, 81.8% were able to demonstrate the expectation.

Another question presented in a real-world context, numerical-response question 10, required students to solve a problem by connecting data to variables in a quadratic equation and its graphical representation. About 47.6% of the students who wrote the examination were successful in meeting the expectation for this question. Of the students who achieved the acceptable standard but not the standard of excellence, 48.1% were able to meet this expectation. Of the students achieving the standard of excellence, 77.1% were able to meet the expectations for this question. Only 12.5% of the students not meeting the acceptable standard were successful with this question. In multiple-choice questions 30 and 31, students were asked to analyze quadratic equations and to demonstrate routine skills such as finding roots and completing the square. About 63% of the students achieving the acceptable standard but not the standard of excellence and 90% of the students achieving the standard of excellence were able to meet this expectation. Multiple-choice questions 32 and 33 required students to analyze a quadratic function in the

Yin noted that a sign advertising a pop sale at Bobby's Fine Food Store was attached to a motor that caused the sign to rotate. Yin used the concept of rotational angles to display on her calculator the coordinate plane and the angle that the sign rotated through. Yin started with the angle 0° at time zero.

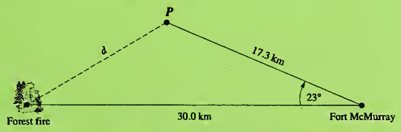
Numerical Response

4. During a time period of 5 seconds, the sign rotates at a constant rate through an angle of 130°. When compared to an angle in standard position, the measure of the angle created during a rotation time of 12.5 seconds is ____________ degrees.
(Record your answer on the answer sheet.)

Answer: 325

Airplanes are sometimes used to drop water on forest fires.

Flying a straight-line, the flying distance between Fort McMurray and a forest fire is 30.0 km. Due to smoke conditions, the planes must first fly 17.3 km at an angle of 23° off this course, and arrive at point P before proceeding to the forest fire.



Numerical Response

7. To the nearest tenth of a kilometre, the distance (d) from a plane at point P to the forest fire is __________.
(Record your answer on the answer sheet.)

Answer: 15.6

context of a trajectory. About 65% of the students achieving the acceptable standard but not the standard of excellence were able to meet this expectation. Of the students achieving the standard of excellence, 89% were able to meet this expectation.

Trigonometry — To achieve the acceptable standard in trigonometry, students must be able to recognize angles and extend right-angle trigonometry to angles in a coordinate plane; use understanding of sine and cosine law to solve oblique triangles; and solve problems that involve triangles and their applications.

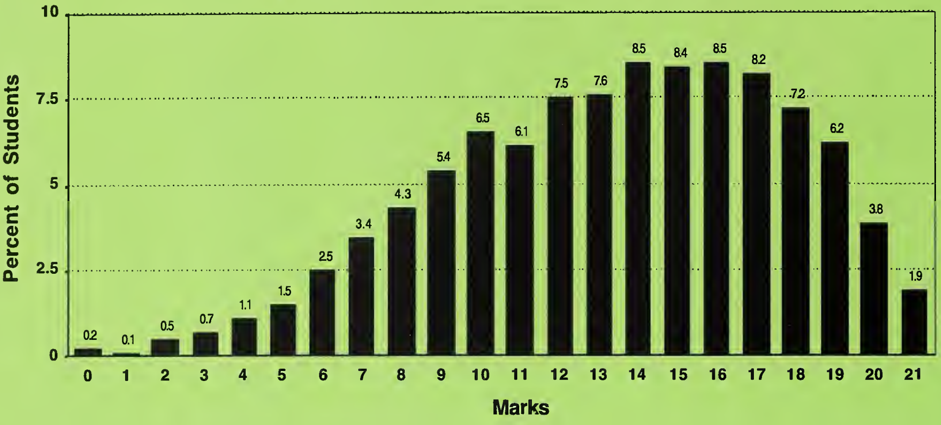
Numerical-response question 4 asked students to link their understanding of angles located on a coordinate plane to an angle created in time by the rotation of an object. About 77% of all students who wrote the examination were able to meet this expectation. About 89% of students who achieved the standard of excellence were able to meet this expectation. About 79% of the students who achieved the acceptable standard but not the standard of excellence were also able to demonstrate this expectation. The ability to extend right-angle trigonometry to angles on a coordinate plane was demonstrated on multiple-choice question 15. About 70% of all students who wrote the examination demonstrated this ability. Of students at the standard of excellence, about 94% were able to meet the expectation for question 15, and about 71% of the students meeting the acceptable standard but not the standard of excellence were also able to meet the expectation for this question.

Numerical-response question 7 required students to solve a problem involving oblique triangles by applying the cosine law. Only 39% of the students who wrote the examination were successful in meeting this expectation. About 76% of students at the standard of excellence were successful in meeting this expectation, compared with a 7% success rate for students who did not achieve the acceptable standard. About 38% of the students achieving the acceptable standard but not the standard of excellence were able to meet the expectations for this question.

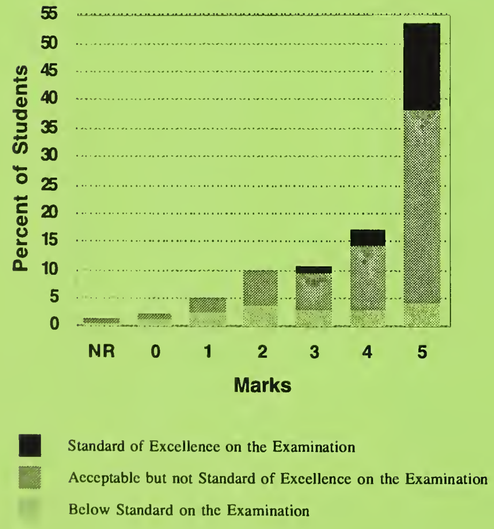
Written-Response Questions

The chart below shows the percentage of students achieving various marks on the written-response questions. The maximum mark obtainable was 21. Questions in the written-response section dealt with four of the seven content strands for Mathematics 33. Students achieving the acceptable standard were expected to obtain at least half marks on all questions. Students achieving the standard of excellence were expected to get almost full marks.

Distribution of Marks for Written Response



Distribution of Marks for Question 1



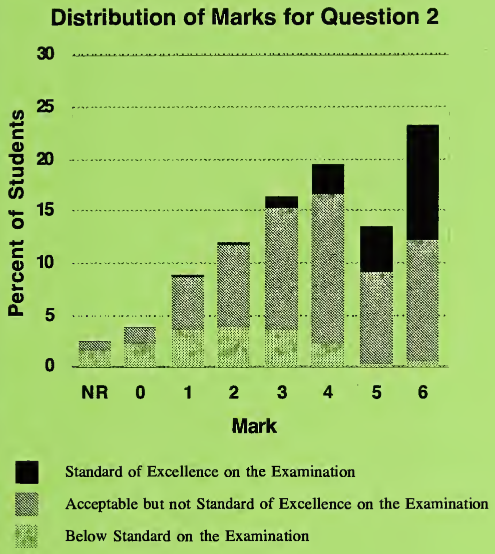
Question 1 required students to interpret and analyze in writing a graph that models a distance-time relationship. Students were first asked to interpret components of the graph, such as the total distance and horizontal segments. Students were then asked to analyze segments of the graph to determine when the greatest speed occurred. The question was marked on a five-point holistic scale and it was expected that students achieving the acceptable level would score at least 3 out of 5 marks on this question. Of the students who achieved the acceptable standard, about 83% received either 3, 4, or 5 marks on this question. Of the students who achieved the standard of excellence, 93% achieved either 4 or 5 marks on this question.

On this 5-mark question, the average mark was 3.94 or 79%.

Markers were asked to comment on student strengths and weaknesses in answering this question. In terms of strengths, they reported that there were a number of good answers and that students used a ratio or slope method to determine the average speed of each segment. Markers were impressed with the amount of writing students did when responding to this question and reported that there were very few "no responses." The markers felt that students achieving either the acceptable standard or the standard of excellence could do well on parts a and b, but that part c discriminated between these two groups. The markers of this item also reported that its location and the order of other test items appeared to present no problem for students.

The teacher marking group indicated that some students were careless in their references to the proper segments of the graph and in communicating their responses.

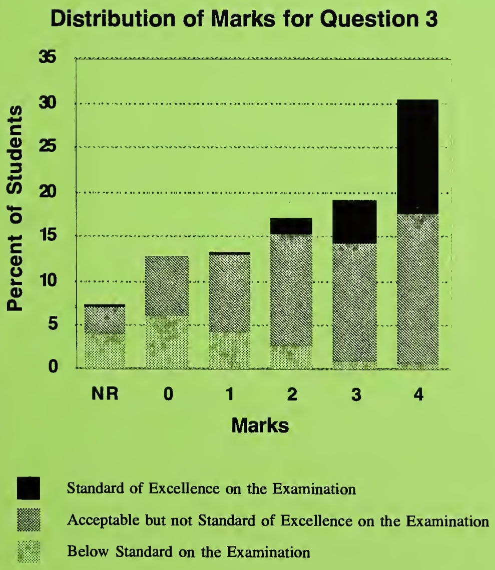
As well, some students showed poor understanding of the problem and did not check their answers for realism.



Question 2 required students to carry out and simplify a rational expression operation that contained binomial and trinomial terms. Students also had to analyze or show an understanding of the effect that the process has on the value of a rational expression. An analytic scale with holistic subparts was used to mark this question. Part a was marked out of 3 marks, part b was marked out of 1 mark, and part c out of 2 marks, for a total of 6 marks.

On this 6-mark question, the average mark was 3.68 or 61%.

Students who achieved the acceptable standard were expected to achieve at least 3 out of 6 on this question. About 74.4% of the students who achieved the acceptable standard met this expectation. Students who achieved the standard of excellence on the examination were expected to score 5 or 6 marks on this question. About 78% met this expectation. The teachers marking this question reported that there were very few “no responses” or zeros. Of the 4 786 students who wrote the exam, there were 101 zeros and 60 “no responses” on this question. Teachers reported that student strengths included a propensity to attempt the question and build an answer. In terms of factoring skills, teachers reported that most students can factor trinomials well, but in many cases, students had difficulty removing the common factor in the expression $x^2 - x$. Most students had no problem determining values for the simplified expression and recognized that a simplified expression is equivalent to the original expression. The teacher markers noted that students made careless errors in operations, wrote incorrect expressions, and, in some cases, could not identify their simplified version. Markers also noted that student responses were sometimes too long and that many students had a tendency to overexplain the solutions. It was also noted that many students did not identify non-permissible values.

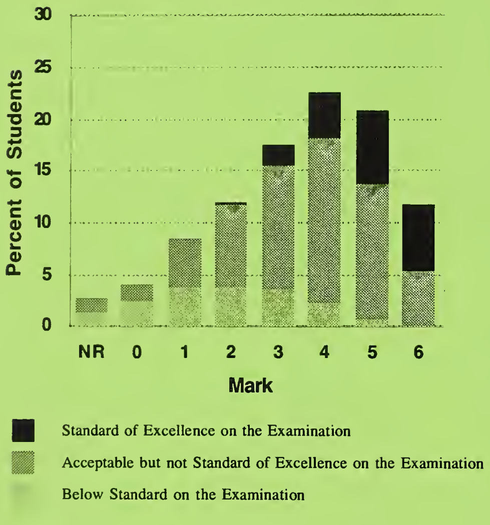


Question 3 required students to apply the sine law to a problem where they needed to determine the missing side of an oblique triangle. The question was scored using a holistic scoring guide with a scale of 4. To achieve the acceptable standard in Mathematics 33, students should be able to recognize the problem as involving an oblique triangle and provide an answer that incorporates a correct strategy. If students were able to demonstrate this, they were expected to score at least 2 out of 4 marks. About 70% of students who achieved the acceptable standard but not the standard of excellence on this examination met or exceeded this expectation. Students at the standard of excellence were expected to communicate a clear and correct answer with supporting details. Of the students who achieved the standard of excellence on this examination, 89% met this expectation .

On this 4-mark question, the average mark was 2.27 or 56%.

Teacher markers reported that a strength in student responses was the number of students who attempted this question. Markers reported that there were a lot of full-mark responses. Of the 4 786 students who wrote the examination, 1 461 were awarded a mark of 4 out of 4. Another strength was the number of ways in which students approached the question. The teacher marking committee reported rounding errors, improper use of units, poor concluding statements, and improper use of mathematical syntax (particularly the use of equal signs) as student weaknesses in answering this question.

Distribution of Marks for Question 4



Question 4 required students to plot bivariate data on a scatter plot, recognize and describe the correlation between variables, assess the strength of the correlation, and interpolate and justify their interpolation. This question was marked using an analytic scoring guide with holistic sub-parts. Part a was scored out of one mark, part b was scored out of two marks, and part c out of three marks. Students who achieve the acceptable level were expected to score at least 3 out of the 6 marks available. Of these students, 73.6% received either 3, 4, 5, or 6 marks on this question. Students who achieved the standard of excellence were expected to score 5 or 6 marks on this question. Of the students who achieved the standard of excellence, 68.3% achieved this expectation.

On this 6-mark question, the average mark was 3.5 or 58%.

The markers felt that student strengths included plotting the data and describing the correlation and what it means. As well, most students were able to predict an answer to the problem within a correct range of values.

Weaknesses of student responses included poor communication skills, and in some cases, difficulty in differentiating between strength and direction of the correlation. It was also noted that many students were reluctant to draw a line of best fit on their scatter plot or refer to their line of best fit as justification for their answer.

For further information, contact Ron Flaig or Yvonne Johnson at the Student Evaluation Branch, 403-427-0010.

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